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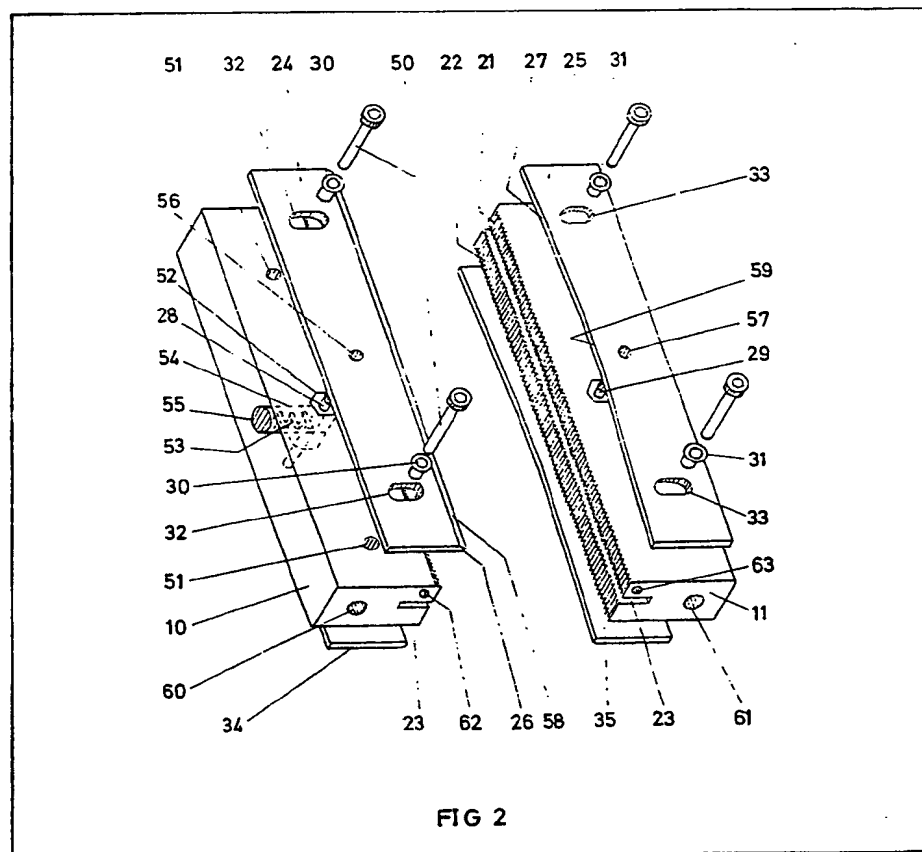
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(54) Jaw sealing assembly

(57) A jaw assembly for forming sealed packages from a tubular web in which conventional sealing jaws 10, 11 are supplemented by resiliently biased web engaging plates 24, 25 positioned to engage, and apply a sealing pressure to, at least the edge portions of the collapsed tubular web prior to engagement of the jaws therewith. The jaws 10, 11 are provided with teeth 22 to form crimp seals and with recesses 23

to accommodate a knife blade. Web-engaging plates 24, 25, 34, 35 biased by spring-loaded pins 28, 29 towards the web path are provided on each side of each jaw. The web-engaging faces 26 of the plates 24, 34 are planar but chamfered at 58 and the web-engaging faces 27 of the plates 25, 35 are recessed at 59 to accommodate overlapping web portions. In a modification, (Figure 7), supplementary sealing plates form edge-reinforcing seals adjacent the crimp seal.



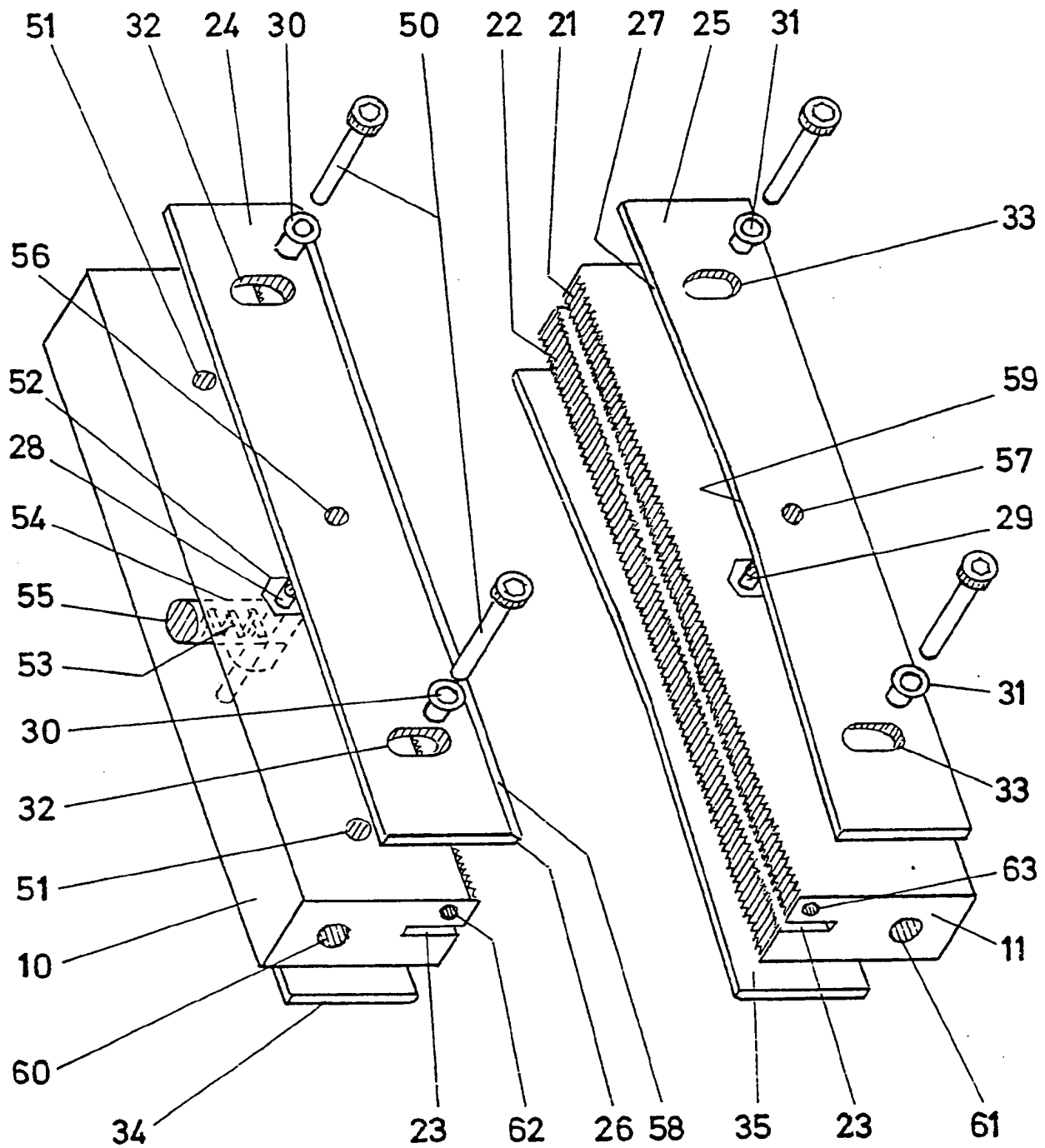
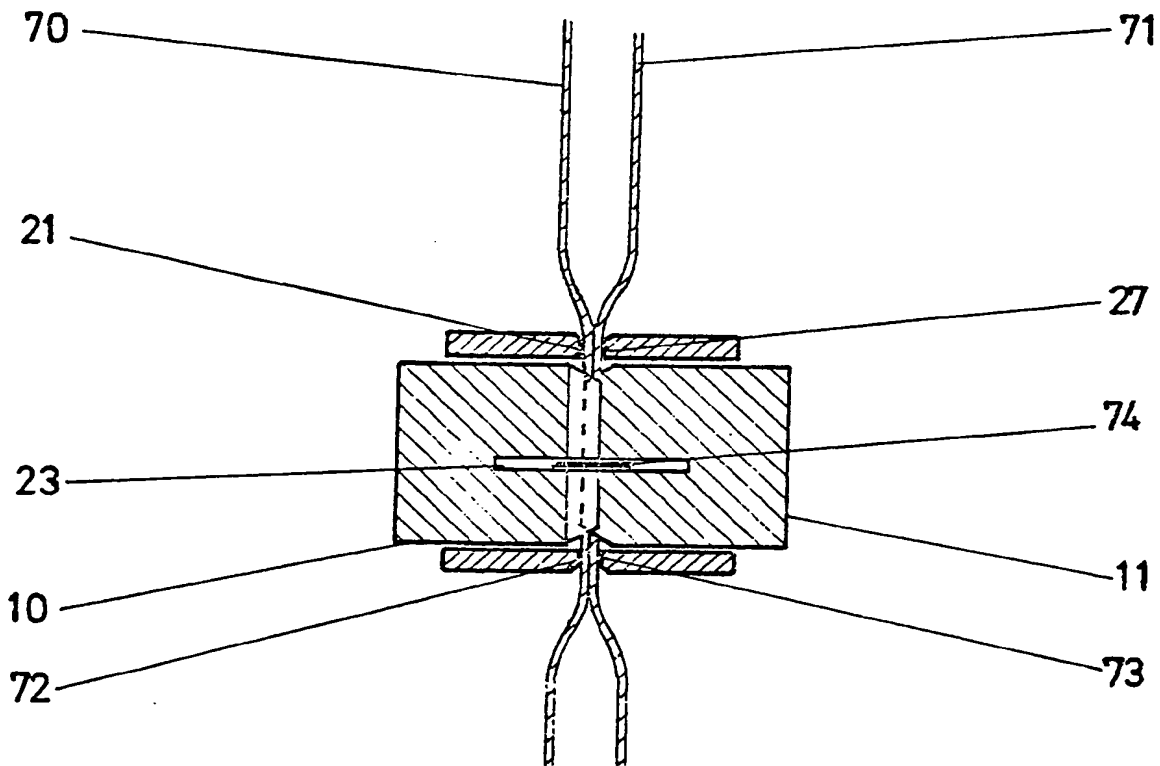
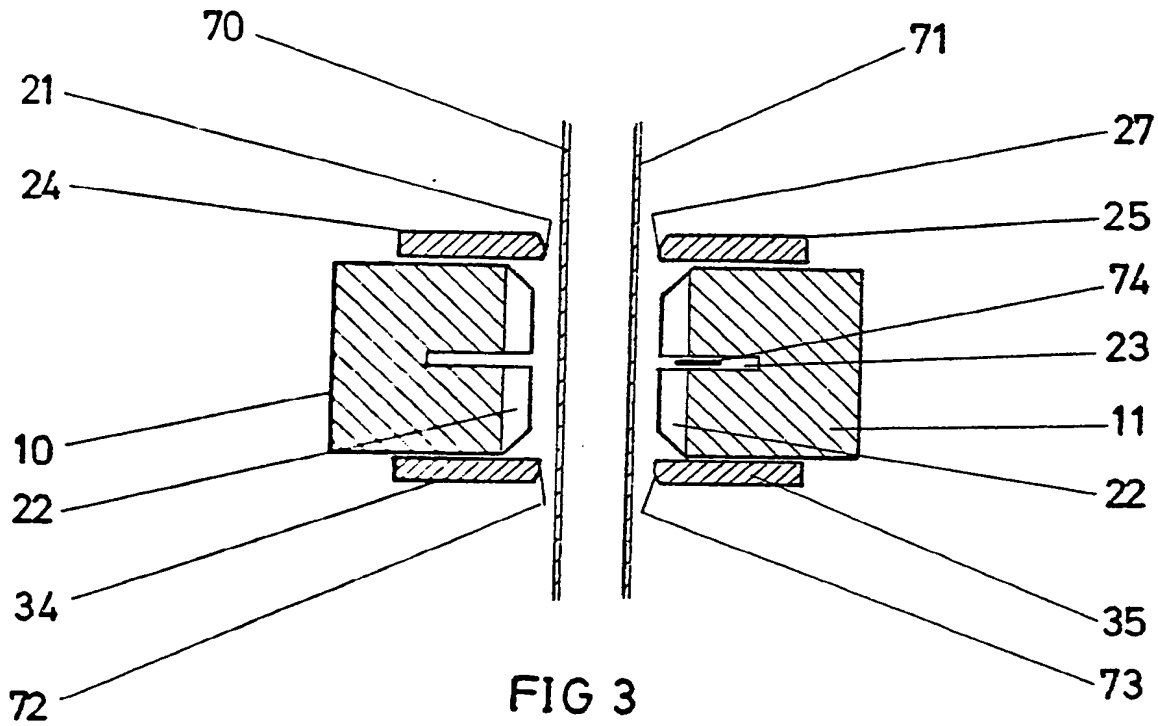


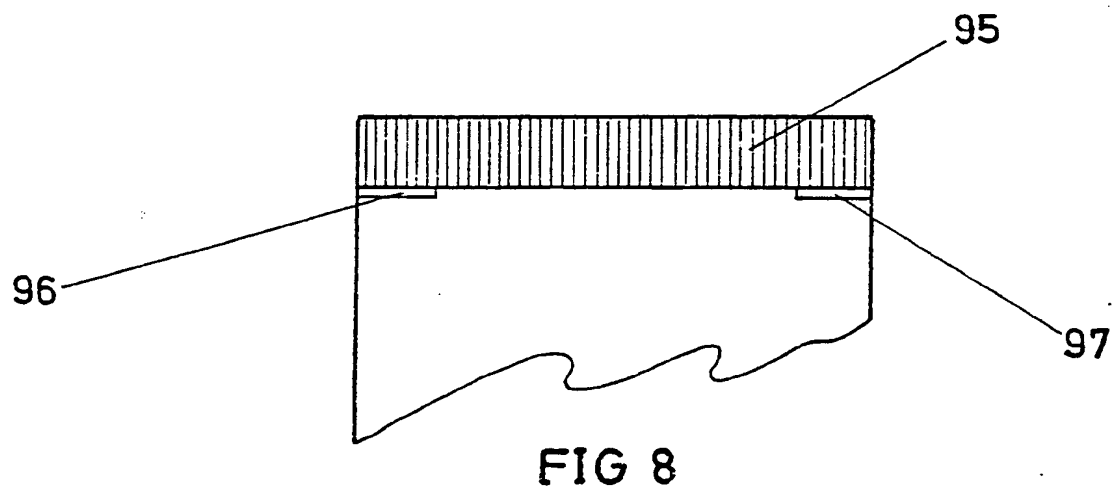
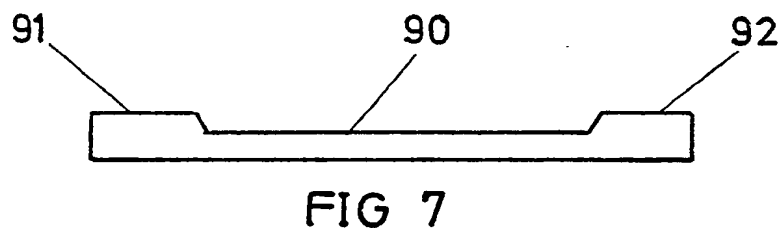
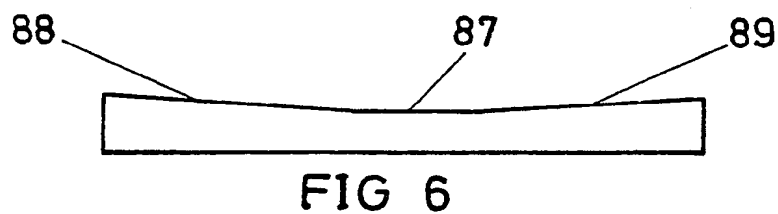
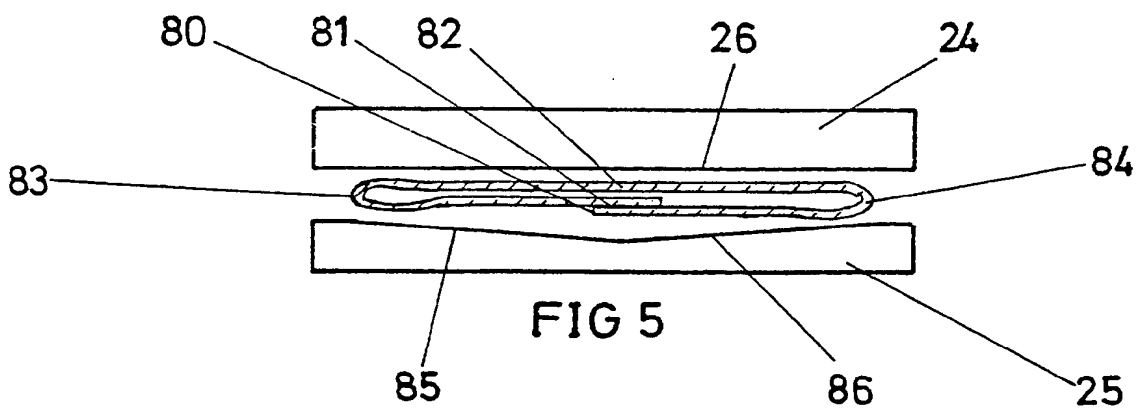
FIG 2

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SPECIFICATION

Jaw sealing assembly

5 This invention relates to a jaw assembly for sealing together a plurality of web layers, and in particular to a thermal sealing assembly for forming heat-seals between adjacent layers of a thermoplastic polymeric film.

10 Modern packaging techniques frequently involve the formation of a package by creating a seal between two opposed layers of packaging web. Thus, in the so-called vertical "form and fill" packaging technique a continuous flat web of packaging film is fed around a forming shoulder where it is
15 shaped into tubular form, and thence over a hollow internal mandrel or cylindrical former where the free longitudinal edges of the film are sealed together to create a continuous tubular film. The tubular film
20 then passes between a pair of intermittently co-operating heated sealing jaws which create a series of discrete packages by collapsing the tubular film and forming a succession of horizontal heat-seals, usually crimp seals, across the width of the film, the
25 desired quantity of product being introduced into each package through the internal mandrel in the interval between the formation of successive horizontal heat-seals.

Because of the resistance to deformation of the
30 packaging film that portion of the tubular film compressed between the sealing jaws does not always adopt a completely lay-flat form and instead assumes a dumb-bell configuration with a bulbous edge portion extending beyond each side of a
35 compressed central portion of the tube. Creation of a completely hermetic seal across the entire width of the collapsed tube is therefore not readily achieved and the resultant package frequently exhibits a "piping" defect in which an unsealed channel extends through an edge portion of the seal area from
40 the interior of the package, thereby enabling the contents of the package to be exposed to atmospheric contamination and allowing the package to deflate. Such defective packages are commercially
45 unacceptable.

We have now devised an improved jaw sealing assembly which enables the aforementioned defects to be eliminated or substantially reduced.

Accordingly, the present invention provides a jaw
50 assembly for sealing together a plurality of superimposed layers of a web comprising a pair of cooperable sealing jaws moveable to and retractable from an operative position embracing the web path in which the sealing faces of the jaws grip and form a
55 seal between the web layers characterised by a pair of cooperable web engaging members one of which is operatively associated with each jaw, at least one of the members being resiliently biased towards the web path relative to, and having a sealing face
60 projecting inwardly of the sealing face of, the associated jaw, so that as the jaws approach the operative position said members cooperatively engage at least an edge portion of the web layers prior to engagement of the jaws therewith enabling the
65 sealing face of said at least one member to apply a

resilient sealing thrust to said edge portions, and, on closure of the jaws, to retract to a median position as hereinafter defined.

The invention further provides a method of sealing
70 together a plurality of superimposed layers of a thermoplastic polymeric film by heating and pressurising said layers in an elongated sealing zone extending between the opposed longitudinal edges of said layers to form a crimp seal having a pattern of
75 longitudinally extending flutes characterised by heating and applying a resilient sealing pressure to said film layers in a region adjacent said sealing zone and extending inwardly from said longitudinal edges to provide a transverse reinforcing seal between said
80 layers at least at the edge portions thereof.

Each sealing jaw may be of any suitable shape but conveniently is in the form of a rectangular block providing a generally rectangular sealing face for engagement with the web, the sealing face being of
85 a width at least equal to, and preferably exceeding, that of the collapsed lay-flat web to be sealed - for example 150 to 200 mm, and having a depth, parallel to the direction in which the web passes between the jaws (the longitudinal or machine direction), sufficient to create a seal of acceptable strength - usually
90 of the order of 10 mm or greater. Each of the long or transverse edges of the sealing face is preferably chamfered to avoid cutting of the web layers when the jaws approach the operative position.

To create an effective seal between the web layers the respective sealing faces of the opposed jaws are preferably provided with a profiled or indented surface pattern - for example, with a regular pattern of serrations interspersed with teeth extending longitudinally on the sealing face parallel to the direction of web travel, the tips of the teeth on one sealing face mating with the serrations on the other sealing face when the jaws are in the operative position.

Each sealing jaw block is suitably fabricated from a
105 rigid material, such as steel or brass, and preferably is adapted to receive means, such as a plurality of electrical cartridge elements, for heating the block to the desired sealing temperature - in the case of heat-sealing jaws. Provision may also be made, if
110 desired, for the inclusion of one or more thermocouples and ancillary temperature control equipment in the block.

To excise successive sealed packages from the continuous tubular web, knife means are provided -
115 conveniently in the form of a retractable blade located within one jaw block in an intermediate recess extending parallel to a long edge thereof. When the jaws have attained the operative position and sealed the web, the blade traverses the web path
120 into an accommodating recess in the sealing face of the opposed jaw block, thereby severing the seal at a position intermediate the long edges thereof so that the portion of the severed seal downstream of the blade in the direction of travel of the web forms the top seal of one package while the upstream portion of the severed seal forms the bottom of the next
125 succeeding package.

In a preferred embodiment of the invention two pairs of cooperable web engaging members are
130 associated with the jaw assembly, one cooperable

pair on the upstream side, and the other cooperable pair on the downstream side, of the jaw assembly in relation to the direction of travel of the web. Each cooperable pair performs an equivalent function, and for ease of description the invention is hereinafter discussed in terms of a single pair of web engaging members.

As hereinbefore described, the cooperable web engaging members operate by engaging at least a longitudinal edge portion of the collapsed tubular web, prior to engagement thereof with the sealing jaws per se, and pressurising the superimposed web layers in that edge region. Each member therefore provides a sealing face for engagement with at least one, and preferably both, of the edge portions of one surface of a layer of the web. Conveniently, the sealing face of each member is of generally rectangular configuration of width not exceeding that of the sealing jaw, and suitably of depth, in the direction of web movement, less than that of the associated jaw. Conveniently, therefore, each web engaging member comprises a generally rectangular plate.

To achieve prior engagement with a web edge portion at least one of the members must be positioned relative to the associated jaw so that the sealing face of that member projects inwardly towards the web path beyond the sealing face of that jaw. However, to avoid cutting the web, while maintaining a sealing pressure thereon, the sealing face of the member should not project inwardly beyond the innermost surface of the associated jaw sealing face when the jaws have closed on the web in the operative sealing position. Accordingly, at least one of the web engaging members should be slideably mounted on the jaw for retraction to a median sealing position in which the member sealing face applies a sealing pressure to the edge portions of the web but does not project inwardly towards the web beyond the innermost surface of the associated jaw sealing face. Maintenance of an adequate sealing pressure is achieved by urging the member into a web engaging position by resilient biasing means such as a coil spring under compression, the required strength of the spring being readily assessed by simple experimentation. The cooperable web engaging member associated with the opposed jaw may be similarly biased, or, if desired, may be fixedly mounted on the jaw - in which case the sealing face of that member should be located at a median sealing position as hereinbefore defined. Sliding of a member relative to the associated jaw may be assisted by the provision of a lubricating layer therebetween. For example, the sliding surface of the member and/or jaw may be coated with a layer of lubricating material, such as polytetrafluoroethylene, or a shim of polytetrafluoroethylene may be introduced between the associated member and jaw - both to assist sliding movement by reduction of frictional drag and to prevent ingress of contaminants and debris which tend to induce seizure of the sliding mechanism.

To ensure effective sealing of the edge portions of the tubular web at least one of the web engaging members preferably comprises a sealing face which

is slightly inwardly tapered from opposed ends towards a central portion thereof so as to present to the web a concave face generally of flattened V form. Suitably the degree of taper per unit width of the face is of the order of 0.002:1, and an arrangement of this kind readily accommodates any lateral displacements of the tubular web which may occur during a packaging and sealing sequence while ensuring that an adequate sealing pressure is applied to the web edge portions. If desired, a central section of the sealing face may be relieved or recessed and only the end portions thereof tapered for sealing engagement with the edge portions of the tubular web. The sealing face of the opposed cooperable web engaging member may be planar, or correspondingly relieved if desired.

Where the tubular packaging web is formed by folding a flat web over upon itself about a longitudinal axis a double web thickness exists along the length of the tubular web where the overlapped longitudinal edges have been sealed together. The area of the tubular web confined between the sealing jaws therefore includes one zone in which three web layers are superimposed. A web engaging member the sealing face of which is relieved as hereinbefore described not only improves the sealing efficiency of the jaw assembly but also readily accommodates this zone of increased web thickness without damaging the web in the operative sealing position.

If desired one or both of the long edges of the sealing face of a web engaging member may be chamfered to avoid damaging the web during the sealing operation.

The jaw assembly of the invention is of utility in forming packages from webs which can be sealed together under pressure, and particularly under a combination of heat and pressure in a heat-sealing operation. Typical heat-sealable webs include thermoplastic polymeric films and laminates thereof, particularly oriented films formed in conventional manner from polymers and copolymers of 1-olefins such as ethylene, propylene, butene-1, and 4-methylpentene-1. A useful packaging film comprises a substrate of a high molecular weight stereoregular predominantly crystalline polymer of propylene, either in the form of a homopolymer or copolymerised with minor quantities (e.g. up to 15% by weight of the copolymer) of at least one other unsaturated monomer, such as ethylene, the substrate having on at least one surface thereof a layer of a heat-sealable material such as a vinylidene chloride-acrylonitrile copolymer. The technique is also applicable to the formation of packages from a coextruded multiple-layer film having a polypropylene substrate with a heat-sealable surface layer comprising a propylene-butene-1 copolymer.

Packaging webs sealable by the techniques of the invention may vary in thickness over a wide range but preferably have a thickness of from 2 to 150 microns. Packaging films are generally within a thickness range of from 5 to 50 microns.

The invention is illustrated by reference to the accompanying drawings in which

Figure 1 is a simplified schematic perspective view

of a jaw assembly and associated mountings,

Figure 2 is an exploded perspective view, not to scale, of a pair of sealing jaws and associated web engaging members,

5 *Figure 3* is a schematic end elevation of a jaw assembly about to grip and collapse a tubular packaging web,

Figure 4 illustrates the jaws of *Figure 3* in the closed operative sealing position,

10 *Figure 5* is a simplified schematic plan view of a pair of cooperable web engaging members approaching the operative sealing position,

Figures 6 and 7 illustrate alternative forms of recessed web engaging members in simplified plan view, and

Figure 8 schematically illustrates a reinforced seal formed at the end of a tubular film package.

Referring to *Figure 1* of the drawings a pair of sealing jaws 10, 11 is mounted for slideable movement to and from an operative sealing position on guides or runners (not shown) on the internal surfaces of limbs 12, 13 of a generally rectangular carriage 14. Reciprocating movement of the respective jaws in a substantially horizontal plane within the carriage is effected by pneumatic assemblies 15, 16 through associated shafts 17, 18.

Carriage 14 is mounted for reciprocating movement in a substantially vertical plane on rails 19, 20.

The sealing face 21 of each jaw is provided with a pattern of elongate teeth 22 cooperable with a mating pattern on the opposed jaw sealing face to form, in the operative position, a crimp seal across the width of a tubular web fed downwardly between the jaws along a web path in a plane embracing rails 19, 20.

35 An elongated recess 23 in each jaw accommodates a reciprocating knife blade (not shown) which is the operative sealing position traverses the web path to sever the web between opposed horizontal edges of each seal formed therein - thereby creating a series of discrete sealed web packages.

On the uppermost surface of each jaw is located a web engaging member in the form of a generally rectangular plate 24, 25, each plate respectively having a web sealing face 26, 27 and being resiliently biased by a spring-loaded pin 28, 29 towards the web path on guide bushes 30, 31, located in slots 32, 33. The latter are preferably dimensioned to fit loosely about the respective guide bushes thereby permitting each plate a limited degree of pivotal movement about its spring-loaded pin to ensure that the plates effectively grip and seal a tubular web which may have wandered slightly from its normal central path between the jaws.

55 A similar pair of cooperable web engaging plates 34, 35, of which only one, 34, is visible in *Figure 1*, is located on the lower surface of the jaws.

Sealing of a tubular web by the assembly involves a cyclic sequence of operations in which carriage 14 moves on rails 19, 20 to the upstream end of its stroke where jaws 10, 11 partially close around a tubular web descending between the rails, the sealing faces of each pair of cooperating plates gripping at least the longitudinal edge portions of the web prior to engagement of the jaws therewith, 65 the carriage assembly descends on the rails to the

downstream end of its stroke pulling the web therewith, the jaws and associated plates fully close sealing together with opposed surfaces of the tubular web, the knife blade severs the sealed web, and the jaws and associated plates retract to an open position prior to recycling of the carriage to the upstream end of its stroke.

70 The jaw and plate assembly is visible in greater detail in the exploded diagram of *Figure 2*, in which, 75 where possible, identical reference numerals are associated with parts already described by reference to *Figure 1*. Thus, referring to *Figure 2*, web engaging plate 24 is slideably located by guide bushes 30 inserted through slots 32 and secured by pins 50 engaging sockets 51 in the upper surface of jaw 10. Pin 28, floating in jaw aperture 52 under the influence of coil spring 53 retained under compression in channel 54 by closure plate 55 engages in socket 56 to urge plate 24 inwardly towards the web path. Likewise, resiliently biased pin 29 engages in socket 57 to urge plate 25 inwardly towards the web path.

The sealing face 26 of plate 24 is planar, although the upstream edge 58 thereof is chamfered to avoid damaging the web, while sealing face 27 of cooperating plate 25 is inwardly tapered from each end to provide a slightly recessed section 59 which accommodates the overlapped longitudinally sealed portion of the tubular web (*Figure 5*). Independently 90 cooperating plates 34, 35 are similarly proportioned and mounted on the respective undersides of jaws 10 and 11.

An orifice, 60, 61 is provided in each jaw to accommodate an electrical heating element (not shown), the web engaging plates being heated indirectly by conduction from, and thereby attaining a temperature substantially identical to that of, the associated jaw. A thermocouple well 62, 63 is also provided in the respective jaws.

105 The sealing operation is illustrated in *Figures 3 and 4*.

In *Figure 3*, the jaw assembly is about to close on opposed layers 70, 71 of a tubular web, the sealing faces 21, 27, 72, 73 of the respective plates projecting inwardly towards the web beyond the tips of jaw teeth 22, and knife blade 74 being retracted in recess 23 of jaw 11.

In *Figure 4*, the jaws have closed to the operative position and sealed the web layers to each other, the sealing faces 21, 27, 72, 73 of the plates have retracted against the biasing spring to a median position in which they continue to maintain a sealing pressure on the web without cutting through either of layers 70 and 71, and knife blade 74 has been projected into recess 23 in jaw 10 thereby severing the web between the upstream and downstream extremities of the seal.

In the plan view of *Figure 5* a collapsed tubular web is shown descending between web engaging plates 24, 25 in a plane substantially normal to that of the drawing. At a position approximately midway between the ends of the plates the tubular web, being formed by folding a flat web over upon itself and sealing the overlapped longitudinal free edges 125 of the flat web to each other, comprises three layers 130

80, 81, 82, while the collapsed tubular web adopts a dumb-bell configuration with slightly bulbous edge portions 83, 84. To accommodate a tubular web of this configuration the sealing face of plate 25 is slightly flared or tapered in the form of a flattened V with limbs 85, 86 arranged to present a generally concave surface to the overlap sealed layers 80, 81 of the web. The degree of taper may be varied to accommodate webs of different thicknesses, but in general is preferably at least 0.002 inches per inch width of face.

The tapered face of plate 25 cooperating with the planar face 26 of plate 24 not only ensures that the sealing faces of the plates contact bulbous portions 83, 84 prior to engagement of the sealing jaws therewith, thereby ensuring that a sealing pressure is applied thereto and maintained for a period longer than that applied to the remainder of the web, but also accommodates the triple-layer central portion of the collapsed tubular web without damage thereto. Lateral wander of the tubular web is also readily accommodated by the ability of the plates to pivot slightly about pins 28, 29.

The single plate illustrated in Figure 6 has a generally concave sealing face comprising a flat central portion 87 with limbs 88, 89 slightly outwardly inclined thereto, while the single plate illustrated in Figure 7 has a central planar-faced recess 90 flanked by two wings 91, 92, the wing faces being outwardly flared in the manner of Figure 6 to a degree of at least 0.002:1.

The sealed packet illustrated in Figure 8 is of the kind frequently employed in the packaging of confectionery, potato crisps, and the like, and includes a conventional crimp seal with a pattern of flutes 95, corresponding to the toothed pattern on the sealing faces of jaws 10, 11, extending in the longitudinal or machine direction of the web, i.e. substantially parallel to the direction in which the web travels between the jaws. Supplementary seals 96, 97, extending transversely (substantially normal to a longitudinal edge) of the web, and applied by supplementary sealing plates of the kind shown in Figure 7, reinforce the edge portions of the crimp seal.

The invention is further illustrated by reference to the following Examples.

Example 1

Using a sealing assembly of the kind illustrated in Figures 1 and 2 of the drawings, a series of discrete packages was formed from a flat multiple-layer film of a propylene homopolymer substrate of 25 microns thickness having on each surface a heat-sealable layer comprising a propylene-butene-1 copolymer (88:12 by weight). The flat film had a width of about 250 mm, and each of the resultant packages, including an overlapped longitudinal seal, had a width of about 120 mm.

The sealing jaws of the equipment were maintained at a temperature of 125°C, and seal formation was effected under a jaw pressure of 35 psi and with a jaw closure time of 0.5 seconds.

Testing of the packages for leakage through the crimped seal area was effected by placing individual

packages into a tank of water under a load of 2 kilogrammes and visually assessing the escape of air bubbles from the interior of the package through the seal. Packages tested in this way exhibited a failure rate (escape of bubbles) of 2%, i.e. failure of one end seal was observed from 25 packages (50 end seals).

Example 2

This is a comparative Example, not according to the invention.

Packets formed from identical film and under identical conditions to those of Example 1 except that the supplementary sealing plates were not attached to the jaws of the sealing assembly, when tested by the hereinbefore described procedure exhibited an average failure rate of 100%.

CLAIMS

1. A jaw assembly for sealing together a plurality of superimposed layers of a web comprising a pair of cooperable sealing jaws moveable to and retractable from an operative position embracing the web path in which the sealing faces of the jaws grip and form a seal between the web layers characterised by a pair of cooperable web engaging members one of which is operatively associated with each jaw, at least one of the members being resiliently biased towards the web path relative to, and having a sealing face projecting inwardly of the sealing face of, the associated jaw, so that as the jaws approach the operative position said members cooperatively engage at least an edge portion of the web layers prior to engagement of the jaws therewith enabling the sealing face of said at least one member to apply a resilient sealing thrust to said edge portions, and, on closure of the jaws, to retract to a median position as hereinbefore defined.

2. A jaw assembly according to claim 1 wherein the sealing face of at least one of the members is capable of simultaneously engaging both longitudinal edge portions of one of the web layers.

3. A jaw assembly according to claim 2 wherein the sealing face of said member is concave relative to said web layer.

4. A jaw assembly according to claim 3 wherein said sealing face is of vee form inwardly tapered from opposed web-engaging ends of the face.

5. A jaw assembly according to claim 4 wherein the sealing face is tapered to a degree of at least 0.002:1.

6. A jaw assembly according to any one of the preceding claims comprising a lubricating layer between the resiliently biased member and the associated jaw.

7. A jaw assembly according to any one of the preceding claims comprising two pairs of cooperable web engaging members, one pair associated respectively with each of the upstream and downstream surfaces of the jaw assembly relative to the direction of travel of the web.

8. A jaw assembly according to any one of the preceding claims comprising means to heat at least one of said jaws to a temperature sufficient to form a heat seal between said web layers.

9. A jaw assembly constructed and arranged substantially as hereinbefore described and with reference to any one of the drawings.

10. A method of sealing together a plurality of
5 superimposed layers of a thermoplastic polymeric film by heating and pressurising said layers in an elongated sealing zone extending between the opposed longitudinal edges of said layers to form a crimp seal having a pattern of longitudinally extend-
10 ing flutes characterised by heating and applying a resilient sealing pressure to said film layers in a region adjacent said sealing zone and extending inwardly from said longitudinal edges to provide a transverse reinforcing seal between said layers at
15 least at the edge portions thereof.

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